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Vol. XIV, No. 18. August 30, 1917

THE JOURNAL OF PHILOSOPHY
PSYCHOLOGY AND SCIENTIFIC METHODS

PRAGMATISM AND METAPHYSICS

"One can not have his metaphysics and eat it too."

AT the recent meeting of the Western Philosophical Association,[1] the symposium, which had been arranged for the principal session, was given to consideration of immortality, the natural world and God from the three standpoints of idealism, realism, and pragmatism. The questions formally propounded, it is true, were not quite as bold and direct as this statement might imply, being these: (1) In what sense does the human person possess independence of his physical organism and environment? (2) What reality has the history of the world as the physical and biological sciences present it? and (3) Does any being exist that plays the part assigned to God in theistic religion? But the actual discussion was by no means confined to such specific inquiries. The actual discussion, moreover, was nearer to being just one more trial of pragmatism at the court of metaphysics than any mere weighing of the relative merits of the three "isms" represented. Certainly there was no keen interest in any of the issues merely between idealism and realism; these two eminently respectable old-timers showed little if any of their earlier animus towards each other; rather did they seem to be in a dual—or should the philosopher say dualistic?—alliance against the *nouveau vrai* upstart, pragmatism. What matters it after all, exclaimed one of the idealists, perhaps in an unguarded moment, perhaps really not caring, whether we call the objects of experience ideas or things? suggesting, of course, that more serious problems may now be confronting us. And a realist and materialist was equally indifferent in that his "isms" were so critical, so free from naïveté, as to enable him to admit, if not insist, that although the material world, the world of science, can be our only world, nevertheless not any science nor even all the sciences can ever exhaust the nature of that world. From which one can conclude only that the real and material world, however revealed through science, is also transcendent, of course immanently transcendent, of science or of matter

[1] Held in Ann Arbor, Michigan, April 6–7, 1917.

as represented by science and so is itself other than a world of things, being—as proved to be the case—in its own natural right also a world of mind. But a query: Might not an idealist, if waxing sufficiently critical in his turn, as confidently find his ideas to be really, albeit not openly, but only immanently, also things, and so, fully cooperating with our realist and having indeed no serious difference with him, help once more to point the moral of it all that whether things or ideas, matter or mind, is no longer the significant question?

But, to recall a phrase from above, pragmatism on trial at the court of metaphysics might well be said to be pragmatism tested by dualism or by monism, idealistic or materialistic or indifferentistic; and just from this point of view the recent symposium had special interest for the writer, suggesting such reflections as follow. Thus, only to give direction to the present report of these reflections, there is this question: Pragmatism, being at least to all appearances quite indifferent to the basal distinction of a metaphysical dualism, the spirit-matter distinction, as well as to many other distinctions which are in solution in this and which accordingly are supposed to have metaphysical ground, is in what sense if in any sense monistic? How far, if at all, does pragmatism deny the distinctions of dualism? Now pragmatism, I submit, is philosophy; it is neither science nor theology. Theology, and with it morality, commonly leans towards an idealistic monism; science, towards a materialistic monism, as is shown in so much recent science-inspired realism; but philosophy, towards an indifferentistic monism. So, once more, in what sense is pragmatism monistic? What is the peculiar meaning of its indifference?

For answer to this question it is important to recognize at once what is, I think, substantially true, but very easily and quite commonly overlooked, that in the history of philosophy most characteristically, that is, in the non-partisan or indifferentist form, monism has been only a corrective of dualism or—better put—a solvent for all of dualism's metaphysical differences, in short a would-be metaphysical peace-maker. So much, possibly, would or should go without saying. Here, however, is the point. Monism has denied or corrected or resolved dualism only as to some particular setting or context, only as to some historic dualism, whether as expressed openly and completely in the form of somebody's outright assertion or as having the labor of its expression divided, as so often in philosophical standpoints, between the idealists of the time and their contemporary realists. Monism, in other words, has been in practise, whatever it may have been in theory or in its own conceit, never anything more or less than relative—in its correction opposing and often undoing

only some traditional dualism and so at the time even clearing the way for dualism in some new guise, under some new system of values, the spirit-matter or ideal-real distinction finding new expression on some other plane. So, for the notable example, was Spinoza's monism a negation of the medieval dualism. After Spinoza that dualism once for all lost caste metaphysically and became only a standpoint or method, as in psychophysical parallelism or—the division of labor again—in intuitional rationalism and empiricism, both of these being rather epistemological than metaphysical in their intent and value. And, the medieval dualism being changed in this way, metaphysically a new dualism came to reign in its stead. The dualistic difference did not die absolutely, but rose to a new level. Spirit and matter, ideal and real, were as opposed as ever, but each with a new content and value. Similarly, to adduce evidence of the same change from another angle, Spinoza's monism was also the undoing of the medieval individual, but, whether Spinoza directly influenced Leibnitz or not, it also, by reducing all individuals as particularistic entities, spiritual or material, in the realm of thought or in the realm of extension, to so many mere modes, equal and coordinate, of the one substance, cleared the way for that new individualism, at once vital or dynamic and microcosmic, of which Leibnitz's monadism was a most important early modern exponent.

Nor in any estimate of monism, of any positively historic monism as a corrective or solvent of a traditional dualism, can one afford to forget those many special distinctions which are always in solution, as was suggested above, in the basal general distinction,—such distinctions, for example, as God and nature, good and evil, truth and error, subject and object, soul and body, and, not to attempt the very long list, any of the other distinctions inhering in life's various problems. In the case of each one monism brings a reduction of the difference *as having metaphysical ground*, makes it mere formal standpoint or medium, significant only epistemologically, and forecasts, not the absolute passing of it, but some new rendering of it,—the whole movement, moreover, involving some achievement in experience. So conditioned, experience is creative.

To sum up, then, generally as to dualism and specifically as to any of its distinctions, dualism is always historic, or contextual, and it is resolved by an equally historic monism and the resolving monism, being relative to a particular situation, only mediates between a passing dualism and a new dualism, which, however like in terms, is new in meaning or real content. Again, to indicate clearly the mediation, the one-time real and metaphysical becomes epistemological and only mediate, and expresses, but "phenomenally," new reality, a new kind of world. Or, to use a phrase quite commonplace

at least in orthodox epistemology, the mediating "forms of experience," which as related to experience are outgrown realities of experience and always harbor some passing dualism reduced or resolved—Kant's forms, for example, space and time and causality, each with its own antinomy or buried dualism—must always lag behind and do always lag behind the real facts or objects of the experience itself. Do such forms have validity for anything but their mediation, their "working" value? Certainly they can not *represent* the reality which they really mean.

But now: In what sense is pragmatism monistic? Pragmatism is monistic in that it sees experience, if I may here so express the matter, as always moving to the resolution of some dualism, of some distinction between formally incongruous things, of some real problem or conflict, and as always, in the process of the resolution, achieving new reality. But pragmatism is also at least equally dualistic. Only pragmatism, as if catching the meaning of dualism in history, refuses to accept dualism as anything but historic and contextual, as ever in any particular context a metaphysical finality, as ever marking the world's fixed structure or composition. For pragmatism, dualism or any of its many distinctions—and perhaps henceforth it were better known, not abstractly, but only through its specific distinctions in real life—is functional rather than merely and finally structural; life, in other words, having its many dualisms, not just ultimately a single dualism. For pragmatism, once more, neither dualism nor monism can be anything but free principles or general motives of all experience, of any complete experience, both of them being always, let me not say merely present, but active in experience, and so being realities of experience in a sense that no static metaphysics could possibly imagine. To the orthodox metaphysicians this may seem to belittle and discredit the meaning of them both most seriously, but surely it does greatly enhance them. The pragmatic view may discredit them as metaphysical "isms," denying them high places in the metaphysicians' synagogue, but—a change well worth while and very timely—it makes them real and vital in every problem of life that ever finds statement and solution. The dualism-monism movement is seen in every question, problem or experiment, however lowly and commonplace, however ordinary and practical, that ever rises in experience and eventually comes to settlement. Already we have found the whole story historically in the medieval metaphysical dualism, the subsequent psychophysical parallelism, and the present-day pragmatic standpoint, but what is thus written large in history, showing a civilization working out a great problem, is only the typical episode of human experience.

It is, furthermore, at least half-way to this appreciation of prag-

matism for realism and idealism each to have found within its own world the supposed difference between their two worlds or say for each to have found the other's world dwelling with fullness of life quite within its own, even as realism has found "matter" active with so different a thing as "mind" or "spirit"; for, to say the least, with such findings the dualism itself necessarily appears to him who will really look in a new light and acquires new value, becoming rather functional than finally structural as to its distinction or difference or, again, as I think can be said also, rather epistemological than metaphysical, and a functional and epistemological dualism quite satisfies pragmatism. With those findings, then, realism and idealism are already virtually pragmatistic, but they are not yet candidly so; they have not yet arrived. In one way or in the other way the prejudice of a singly structural metaphysics still prevents candor and fulfilment or arrival. The necessary indifferentism is still impossible. So, while a critical realism and materialism and an equally possible critical idealism are excellent fuel for pragmatism, they are not and never can be more than good fuel. They must always need the firing. Real pragmatism must be quite indifferentistic; philosophical, to recall what was said above, not theological and moralistic nor yet scientific.

Pragmatism's interest, as is generally known, is not in matter or mind; it is not in sensuous perception or abstract conception; it is not even in *what just is* under any name or in *what is just known* by any faculty; for these interests and many like them obviously are consequent upon a metaphysical dualism implying ultimate singleness and fixity of the universe's structure and so a mind that can be only either receptive or abstract and a real world whose reality must end with its being and being known. To such a dualism, too, monism could come only negatively, only from outside, only as opposition without use or negation without any solution. But dualism and monism have been shown to be quite different and, consistently, human interest, as represented by the new philosophy, is in situations, problems, experiments, solutions, constructions, achievements and the like,—man's business being no longer to have reality or be it or know it or speculate abstractly merely about it, but, because he has it already, to use it and, using it, to achieve more of it. The metaphysical becoming epistemological, the real becoming mediate or instrumental, the "forms" or instruments so acquired valued for their achievement instead of for their representation or mere formal adaptation—this is human experience as pragmatism feels it. And, again, so conditioned, experience is itself real, a real and living thing—so different from that experience just of something—instead of itself doing something—to which the at last passing dualism had

no choice but to condemn us. Perhaps, after all, pragmatism is more a life or a manner of life than a formal and visible or tangible "ism"; but, if so, it need not be less truly a philosophy; nor need less be expected of it.

But, finally, what of pragmatism and metaphysics? I venture to say that pragmatism, while possibly not satisfying any known metaphysician, is, nevertheless, really big with the metaphysical. To speak more boldly than intelligibly, it so nearly identifies experience with reality as to render a metaphysics gratuitous if not also unseemly. So long as reality was substratal and clothed—with apologies for my metaphorical violence—a metaphysics had some point and, properly timed and placed, was not impertinent. Or, to indulge even in another figure, in its superiority to metaphysics pragmatism can hardly be an exception to the old rule, here slightly paraphrased, that one can not have one's metaphysics and eat it too. Simply in pragmatism the metaphysical cake has been absorbed. If dualism and monism in any way pertain to metaphysics, then, since these "isms" have at last come right up into experience as living principles instead of being speculative and formal assertions about the world beneath or behind experience, pragmatism is—only how shall I put it?—certainly not a metaphysics, but metaphysical at every pore, the cake, I suggest, having proved very rich indeed. If pragmatism may be trusted, the metaphysics of many centuries and many peoples has at last begun to identify itself with human life, reality making itself felt immediately in experience, experience being now seen as a sort of "recapitulation" of Christendom's history, and, being thus put to work, the metaphysical, long abused for idleness and unproductiveness, may end by making for us a new world. When reality works in place of phenomenality, when it succeeds the formal institutions of men, these becoming instruments valid only for what they do, creation must ensue. New life in a new world must be at hand. Pragmatism, then, truly may not satisfy any metaphysician, but at least this may be said of pragmatism: As a standpoint, as distinctly not a metaphysics, it must mean, or at least it may mean, man at last deliberately entering upon adventures in the world of reality, and bent, as he sets out, on really and effectively using reality or on putting all that he himself has found or made to the use of reality and so all in good time on enjoying the creative life of reality thus set free in his own life.

The creative life of reality! To appreciate just what this means here one must recall the indifferentism of pragmatism. The creative life of reality can lie only in a constant union of the ideal and the materially real, of spirit and matter. As an "ism" in history, pragmatism, indifferentist pragmatism, following the medieval dualism

and the subsequent parallelism, calls for candid intercourse, for free and constant interchange, between the values of life and its machinery. Thanks to the too-persistent past, civilization is still suffering from the divorce of these, involving a separation of ends and means, of life's ideal purposes and loyalties and its instruments. Doubtless, at least as must appear in retrospect, such a separation was natural during a militaristic and absolutistic social order. It may have had, too, some point during the earlier years or centuries of the succeeding industrial organization of society, when interest in mere conquest still gave sanction to the principle that life's ends justify any means. But, if industrialism and its accompanying democracy are to prove productive, making some contribution to civilization, the separation can not continue. Thus the soldier, destined for another world, has too long been the romantic figure. The mechanic, master of this world and working for results here, must henceforth take first place in romantic interest. Culture and ideality generally have too long stood aloof, idealizing the past and dreaming, however beautifully, of the future, and practical life, machinery its instrument and science its law, has too long been just practical or "efficient." Culture and efficiency, ideality and practicality, life's deep human values and its nowadays wonderfully devised and wonderfully effective instruments must be wedded as never before, state and school and church all so reorganizing themselves as to make the union, in the first place, quite possible and, in the second place, as it is realized, positively effective. Pragmatism, involving as it does the union of ideality and practicality, or spirituality and real life, of values and instruments, would change the present. Eschewing metaphysics, it would itself realize something.

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THE NATURE OF SCIENTIFIC MATTER

SCIENCE has both form and matter. The form of science known as scientific method is concerned with the ways of observation and experimentation, the kinds of classification, the nature and derivation of scientific laws, and the like. It is the machinery which transforms mere fact into scientific knowledge. It has been carefully examined and is discussed in nearly every book on logic. There has been a tacit assumption, moreover, that the form is all there is to science; that it makes no difference what the matter is so long as the form is correct; that, in short, any rubbish can be put into the machine and come out science. The assumption simply is not true. Just as much care has to be taken of the matter of science as of its

form. If not, the machine clogs at a certain point and the matter can not be refined any further. Yet the matter of science has been most strangely neglected.

The matter of science is what science describes, the objects about which laws are made. With a few exceptions it is the data of science. Now, unless science is to be a mere catalogue of curious events, it is apparent that facts must be comparable with one another. Without the means of comparing facts no laws could be made, no system organized. High degree of system is possible only where there is high degree of comparability. Consequently, just as the degree of advancement of a science may be estimated on its formal side by its degree of systematization, it may be estimated on its material side by its degree of comparability. The principle which governs the material side of science throughout is comparability. The evolution of scientific matter appears as a continuous endeavor to reach a least common denominator of facts.

This endeavor is marked by three stages: First, an interpretation of all facts in terms of data of a common sense. Secondly, a reduction of these data to certain entities called units. Thirdly, a reduction of these units to certain elementary units. I will examine each of these stages separately.

First, it is necessary to find an interpretation of all facts in terms of a common sense. For if we cast off for a moment all our scientific learning and consider the various senses as the simplest savage might, they will appear to us as so many little islands with impassable gulfs between. How could one see a sound, how taste a sight, or smell a prick? Each sense seems cut off from every other, and there seems to be no means of communication among them. Yet in spite of this apparent incommunicability, we know that a single object can be experienced in a multitude of senses. I see a rose, hear its rustle, smell its fragrant odor, and am pricked by its thorns. There seems to be a certain parallelism of the senses such that within limits they can be compared point for point. We can not see roughness, but we can see a corrugated surface and correctly interpret that as roughness. Then we can dispense with the sense of touch so far as it informs of roughness.

This power of interpreting one sense in terms of another is extremely important for science. For our experience, the crude facts, comes to us through many senses, so that if we could not interpret one sense in terms of another, the facts coming to us from each of the senses would be totally isolated from those coming to us from any of the others. Comparability of facts would then only be possible within a sense. There might be many little sciences, one for each sense, but no science. The first step therefore, that science must

make towards comparability of facts is the interpretation of all facts in terms of a single sense. What sense will that be?

Just exactly why *a priori* science should choose sight, I do not know. There is no one characteristic by which sight can claim a clear superiority above all the other senses. It is very sensitive, but probably not more so than hearing or even smell. It has one great advantage over hearing and smell, however, in that it can sense a number of objects at the same time clearly distinguished from one another, while hearing and smell blend and confuse their objects. But sight must share this advantage with any of the touch senses. The combination of clearness and delicacy, however, makes a sense peculiarly well adapted for measurement. Besides, sight is the best distance sense, the most accurate in determining directions as well as the one able to inform of objects furthest away. It is probably the combination of all these qualities rather than any one of them that decided scientific preference in its favor.

But if there is no incontrovertible *a priori* proof why sight should be the scientific sense, there is abundant *a posteriori* proof in the sciences. I shall summarize the data employed in determining the principal facts in the science of sound. It is apparent that the natural sense to use in observing the facts of sound is hearing, and if sight is employed even here, there must be a strong predisposition on the part of science in favor of sight.

The principal facts about sound are pitch, loudness, quality, velocity, reflection, refraction, and interference.

The pitch of sound is determined by the number of vibrations per second in the air. The commonest instrument for the determination of pitch is the siren. The siren in principle is a revolving disk with a given number of holes in it, through which air can be driven. By means of a mechanical counter the number of revolutions of the disk per second can be seen. Multiplying the number of holes in the disk by the number of revolutions per second it makes, one gets the number of vibrations per second produced, which is the pitch of the sound. The ear is of no avail in the experiment.

In comparing some note of given pitch, however, with the siren in order to determine the pitch of the given note, the ear is often used to tell when the note of the siren is the same as that of the given note. But if great accuracy is desired, as in the comparison of tuning-forks, the ear is deprived even of this function. For when a mirror is attached to the end of a vibrating fork and made to cast a beam of light on a screen, the light will make a characteristic line on the screen. When, then, a beam of light has been reflected to this first fork from a mirror attached to another fork vibrating at right angles to the first one, certain characteristic figures (Lissajous's figures)

will be made on the screen, which determine with great accuracy the relative frequencies of the two forks. Thus vision again displaces hearing.

In determining loudness, hearing alone is used. But very little space in physics is devoted to the loudness of sound. It is usually just mentioned. The following quotation from Poynting is significant: "Up to the present time no simple and satisfactory method of measuring loudness has been devised, since it never has been of practical importance to obtain a measure."[1] That is to say, scientists have not yet become much interested in the loudness of sound. Hence it is still described in terms of hearing.

Until recently the ear had to be used as a detector in determining the quality of sound, though sight did all the rest of the work. The quality of sound, it was discovered, is attributable to the composition of the waves. Helmholtz devised a scheme to analyze waves by means of resonators—metal bulbs so constructed as to vibrate sympathetically only to a given frequency of vibration. These were put to the ear and the complex sound in question given. If the resonator could be heard, the experimenter might be sure the complex sound had the note of the resonator as one of its components. What the note of the resonator was would have to be determined previously by one of the methods described above for determining pitch. Most of the material in Helmholtz's experiment, therefore, was visual, though the ear had to be employed as a detector.

But Ames writes: "In the best and most recent work on the analysis of sounds, phonographs are used, and the traces magnified."[2] In the best work, therefore, the data are entirely visual.

The most careful experiments on the velocity of sound were performed by Regnault. The source of the sound was the firing of a pistol. As soon as the shot went off, it cut a wire across the muzzle of the pistol. That broke an electric circuit and registered the time of firing on the revolving drum of a chronograph. The sound wave was received at a distant station by a wide cone fixed to a cylinder which was closed at the further end by an india-rubber membrane. In the middle of the membrane was a light metal disk, so that when the membrane was driven back by the impact of the sound wave, the disk touched a metal point, completing an electric circuit which was immediately registered on the drum of the same chronograph that registered the time of firing. The data from the measurement of the distances between the pistol and the membrane and the data from the drum of the chronograph constituted all the data for determining the velocity of sound, and all the data are visual.

For experiments on reflection, refraction, and interference of

[1] Poynting and Thomson, *A Text-book of Physics*, "Sound," 1914, p. 8.

[2] J. S. Ames, *A Text-book of General Physics*, pp. 396–397.

sound, the ear is sometimes used as a detector, but more frequently Koenig's manometric flame. This flame is a gas jet issuing from a pinhole burner, the pressure of the gas being so regulated that the flame is on the verge of flaring and will flare on the least disturbance in the air. If great accuracy is desired, the flame can be reflected in a revolving mirror in which every movement it makes can be plainly seen. In this form the flame is useful not only as a mere detector, but as a direct means of determining the frequency and composition of sound waves.

All the other data in experiments on reflection, refraction, and interference of sound—such as wall surfaces, rudder lenses, and interference tubes, and the various measurements of these—are in visual terms. Hence, when these experiments are carefully performed with Koenig's flame as a detector they are completely in terms of sight.

Summing up, we find that the great bulk of data in the science of sound is visual; that in all the most accurate and careful experiments, visual data alone are used; that in experiments of a lesser degree of accuracy, the ear is used as a detector, but the rest of the data are visual; and that loudness alone appears to depend wholly on auditory data, but that physicists hasten to apologize for their neglect of the subject and the crudeness of their data for it.

Thus the science of sound exhibits a strong tendency away from the sense of hearing in the selection of its data and towards the sense of sight. A similar tendency may be observed in the science of heat, where one would naturally expect the data to be selected by the senses of warmth and cold. Also one would expect chemical data to be selected by the chemical senses, taste and smell. Yet in all these sciences sight is preferred. It is evident, therefore, that sight is the sense chosen to accomplish the first step towards universal comparability of facts, the sense in terms of which all facts must be stated in order to have a lasting scientific value.

But it is also evident that the reduction of all facts to visual data is only a first crude step towards comparability. The second step becomes necessary—the reduction of visual data to units. Examples of scientific units are atoms, molecules, centimeters, grams, ergs, volts, amperes, ether waves, air waves, degrees Centigrade, degrees Fahrenheit, biological cells, *etc., etc.* But what is a scientific unit?

The first notion that occurs to one is that it must be the smallest datum of a group of data—*i. e.*, of a science—for how could a smaller datum be reduced to a larger datum? We are, however, constantly reducing smaller to larger data. The scientific unit of length is the length of a certain platinum bar in Paris when at a temperature of zero degrees Centigrade. It is known as a meter. But most scientific

facts are stated in terms of a centimeter, which is a hundredth part of a meter, and it is not infrequent to hear of thousandths of a centimeter or even smaller fractions. The unit of length, therefore, is not the smallest length ever measured in physics, but a relatively long length. Practically all mechanical, electrical, and thermal units are of this kind. On the other hand, there are units that are not divisible, and are consequently the smallest in the science that treats of them: for instance, the cell of biology. Nothing can, therefore, be asserted offhand concerning the size of a scientific unit.

The next thought that occurs to one is that a scientific unit must be a purely arbitrary thing. Under certain circumstances it is arbitrary within limits—arbitrary in the same way the choice of the common denominator of a group of fractions is. Any multiple of the least common denominator of a group of fractions would do for comparing them, but arbitrarily the least common denominator is chosen. The arbitrariness of the choice lies only within the multiples of the least common denominator. The choice of some one among the multiples is necessary. In the same way certain units are arbitrarily chosen, as, for instance, the unit of length. Any length would have done for a unit. The choice was arbitrary among lengths. But the unit was necessarily some length. One can not measure the height of a man by sourness or the distance across the Atlantic by claps of thunder. Yet in certain cases, where, so to speak, there is no multiple, the choice of the unit is absolutely necessary, as, for instance, the atom of chemistry.

A scientific unit, therefore, is not necessarily the smallest datum in a science, nor is it ever entirely an arbitrarily chosen datum. A curious characteristic of some units still remains to be mentioned. A unit need not necessarily be a datum at all. I am thinking of the atom, the air wave, the ether wave, and such units. This characteristic is especially astonishing when one reflects that the first step towards comparability of facts is a reduction of all facts to visual terms. In these units, the labor of that first step is apparently thrown away. Only apparently, however, for in every case of this kind the unit is one that could be seen if vision were sufficiently acute. The unit is in visual terms, though invisible. If it were not in visual terms, it could not possibly make visual data comparable, which is its function.

We may, then, define a scientific unit as an entity in visual terms by means of which visual data are rendered comparable. Those data which a unit renders comparable form a group in virtue of that fact. Such a group is called a science. A science, then, is formed and defined by its units. I say "units" in the plural because in some cases it takes several units to render a group of data comparable, and the

science would consequently have to be defined by all the units together. Mechanics is a case in point, where groups of data become comparable only through the combined agency of four units—the centimeter, the gram, the second, and the radian. Usually, however, one unit is enough, as, for instance, in biology the cell, in anthropology the man.

The state of science brought about by the second step in scientific evolution is, then, a multitude of isolated sciences, each of which is defined by one or a few units, which render comparable a large group of facts. There is thus zoology defined by the unit, animal; botany by the unit, plant; biology by the unit, cell; chemistry by the unit, atom; mechanics by the four units just mentioned, *etc.*

But this is manifestly not a final state of science. To have isolated sciences, not to be able to compare the facts of one science with those of another, is too provoking to be long endured. Hence, the third stage in scientific evolution arises, in which units are made comparable with one another. The sign of this stage is the appearance of a distinction between elementary and derived units. As soon as this distinction is recognized, two processes take place: On the one hand, old units defining isolated sciences are ordered and made dependent on one another—some being made elementary, others derived. On the other hand, new derived units spring into existence depending upon the original units which defined the isolated sciences. Altogether, there takes place among the sciences at the same time a tremendous consolidation and a most intricate differentiation.

An example of the first process is the consolidation of botany, zoology, anthropology, physiology, and numberless other more or less isolated sciences of a century ago into the one big science of biology. The cell is the elementary unit from which the units plant, animal, man, tissue are derived. Botany, zoology, anthropology, physiology, *etc.*, are derived sciences dependent on biology.

An example of the second process is mechanics. This science, as I just said, is based upon four elementary units—the centimeter, the gram, the second, and the radian—from which no less than nine derived units have been made. They are the following:

1. cm. x cm. = unit of area, or square cm.
2. cm. x cm. x cm. = unit of volume, or cubic cm.
3. $\frac{\text{gm.}}{\text{cm. x cm. x cm.}}$ = unit of density, unnamed.
4. $\frac{\text{cm.}}{\text{sec.}}$ = unit of velocity, unnamed.
5. $\frac{\text{r}}{\text{sec.}}$ = unit of angle velocity, unnamed.

6. $\frac{\text{cm.}}{\text{sec. x sec.}}$ = unit of acceleration, unnamed.

7. $\frac{\text{gm. x cm.}}{\text{sec.}}$ = unit of momentum, unnamed.

8. $\frac{\text{gm. x cm.}}{\text{sec. x sec.}}$ = unit of force, or dyne.

9. $\frac{\text{gm. x cm. x cm.}}{\text{sec. x sec.}}$ = unit of energy, or erg.

These derived units were quite literally derived from their elementary units. That is to say, the dyne, for instance, was built up out of centimeters, grams, and seconds; it did not break down into centimeters, grams and seconds. The process here is exactly the opposite from the first process, though the result in the two cases is the same, *viz.*, comparability of units. In the former case, analysis shows certain units to be derived from other elementary units. In the latter case, synthesis shows derived units composed of elementary ones. The two processes go on more or less together, and are mutually helpful. For example, by analysis cells have been broken up into their chemical constituents, and thus proved to be units derived from atoms; at the same time, by synthesis atoms have been put together and things that are virtually cells constructed, thus proving again that cells are derived from atoms. At once, the facts of biology and chemistry become comparable.

The final result towards which this third step in the evolution of scientific data aims is a complete comparability of facts throughout the whole range of knowledge, brought about by an arrangement of units such that all units are derived from a certain few elementary ones. Science is already sufficiently advanced to indicate what those elementary units will be. They will be the centimeter, gram, second, and radian.

For all the physical sciences flow directly into these four units. Chemistry is in terms of atoms; and atoms are characterized by their relative weights and are theoretically, at least, regarded as centers of force, both of which facts point to their ultimate reduction into terms of centimeters, grams, seconds, and radians. Biology is founded on the cell, and the cell, as I observed, is derived from the atom, so that ultimately cells also would be derived from centimeters, grams, seconds, and radians. The big established sciences, therefore, —physics, chemistry, and biology—are rapidly rolling towards the consummation of scientific evolution, towards complete comparability of all facts whatsoever through the interpretation of them in terms of the ultimate elementary scientific units, the centimeter, the gram, the second, and the radian.

Thus we see in a wide way what science is doing on its material

side. It is making a continuous endeavor to reduce all facts to a single least common denominator through which alone a universal comparison of facts is possible. Its first step in this endeavor is to sift out of the facts all except visual data. Auditory, olfactory, tactual—all kinds of data other than visual data are retained only in the complete absence of pertinent visual data.

The second step is to mold these visual data into a system of units —centimeters, cells, atoms, *etc.*—by means of which bodies of knowledge are separated. Within these bodies of knowledge all facts are comparable, and each body is known as a science. These bodies of knowledge are scattered, more or less isolated, standing to each other very much as one nation stands to another in a nationalistic state of society. There is complete comparability of facts within a body of knowledge defined by scientific units, but there is virtually no comparability of facts between the different bodies of knowledge.

Then the third step is the organization of the units themselves into a system where each unit is comparable with each other unit, and where consequently any fact of any body of knowledge is comparable with any fact of any other body of knowledge. This step is accomplished by subordinating units to one another, and calling the fundamental units elementary and the subordinate ones derived. The final result of this third step will be the subordination of all units to a few fundamental ones. We are even able to foretell what these fundamental units will be. They will be the centimeter, the gram, the second, and the radian. When all science is interpretable in terms of these units, it will have reached its goal on its material side.

From the crude fact to the visual datum, from the visual datum to the scientific unit, from the scientific unit to the organization of units, and the ultimate interpretation of the fact in terms of centimeters, grams, seconds, and radians—we see the transformation of sensation into scientific knowledge.

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DUALITY AND DUALISM

IN what follows I am not to be understood as arguing in behalf of epistemological monism. So far as I know I have not a chemical trace of interest in it. And if my argument does not on that account run in behalf of epistemological dualism, it is because dualism appears to me only two monisms stuck loosely together, so that all the difficulties in monism are in it multiplied by two. If my position must be labeled, I should prefer to call it empirical pluralism, for it is actuated by respect for the plurality of observable facts.

To my mind the logic of Dr. Drake[1] is unduly simplified. It amounts to assuming that wherever you have numerical duality in perceiving there you have epistemological dualism. Now there is numerical duality in perception, namely, the difference in time and place, *etc.*, of the organic event of sensing, imagining, *etc.*, from that of its extra-organic cause. Consequently there is epistemological dualism. Q.E.D. Whether this argument affects the monistic realists or not is for them to determine. But an empirical pluralist is certainly untouched by it. To him the duality is also a triplicity, a fourness, a fiveness, . . .; and in addition the numerical diversity, however great or small, has nothing to do with knowledge. It is of precisely the same nature as the numerical diversity in any train of events which is construed as causes-effects—or antecedents-consequents. The affair of knowledge enters in only when one of the series is *used* as evidence for inferring some other one in the series, whether antecedent to it or consequent upon it. Only when the numerical diversity of evidence and what is inferred from it becomes an adequate ground for epistemological dualism, will the numerical duality of extra-organic cause and intra-organic event, which is found in all perceptions, even set a problem for an empirical pluralist.

I might well leave the matter here. But it happens that Dr. Drake uses terms which show what the cause of his difficulty is. He says: "The question is: Do the images exist in the object, are they numerically identical with some parts of it, or, are they numerically different, existing at other points in space, and only similar to it and representative of it"? Now so far as his reference to me is concerned (and the same holds as to his earlier article),[2] the last clause, "similar to it and representative of it," shows that he has missed the point of my analysis of perception and of knowledge by means of perception. For Dr. Drake assumes that I must hold what he holds; namely, that the organic sensory-cerebral event (sensation-image in the usual phraseology) *is* intrinsically *representative* of its extra-organic cause; in short, is in its very occurrence a fact of the knowledge order or genus. Now this is just what I deny, holding that the event *becomes* cognitive only when *used* as representative, that is to say, as evidence for inferring some other event. Smoke is numerically different from fire, has (or may have) a different locus in space, exists at a different time, *etc.* But it is not inherently representative of fire, although we learn to use it as sign or evidence or representation of fire. This sort of physical numerical duality is literally that which I find figuring in all knowledge. And as I have already said, there is always *more* than duality. The smoke affects my nostrils—there is a smell; my eyes—there is a sight. The smell, the

[1] This JOURNAL, Vol. XIV., especially pp. 368–69.

[2] This JOURNAL, Vol. IX., p. 152.

sight affect my brain, my muscles. A whole series of physical effects is found in every case of the happening of sensory responses. A popular account would be content to say that we go direct from smoke to inferring fire. A more careful one will say that we go from an intra-organic event to smoke and from that to fire. But this is the difference between a more careful and extensive account and a rougher, more summary account. It is a difference in the detail of a series continuously physical in all its constituents. At no point is there a switch from one order or genus of Being to another. And without such a switch there is neither epistemological dualism nor does the demand for an epistemological monism arise. The key to the notion that there is such a switch (to be formulated in a dualism or explained away in a monism) arises from failing to note that representation is an *evidential function* which supervenes upon an occurrence, and from treating it as an inherent part of the structure of the organic events found in sensings. There are no physical events which contain representation of other events as part of their structure. Hence a separate world called psychical is provided for these hasty products of elision and telescoping.

To avoid misunderstanding let me say that the retort that the smoke is not a "conscious datum" while sensations and cerebral events are conscious data is not a reply, but a repetition of the same ignoring of the position. For the position herein recapitulated holds that to call anything "conscious" (so far as the requirements of this argument concern the word) is simply to say that it figures within the inferential or evidential function.

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REVIEWS AND ABSTRACTS OF LITERATURE

Wissenschaftslehre. B. BOLZANO. *Hauptwerke der Philosophie in original getreuen Neudrucken.* Band VII. Neu herausgegeben von Alois Häfler. Leipzig: Verlag von Felix Meiner, 1914. Zweiter Band. Pp. viii + 568.

In Volume II. of the *Wissenschaftslehre,* Bolzano continues[1] his exposition of the "elementary theory" of which the first part was considered in Volume I. The second part Bolzano devotes to general qualities of propositions and classification of propositions. This classification is made first, with reference to properties (Vol. I., § 80) and second, with reference to relations. A final chapter of the second part contains an exposition of propositions containing terms having

[1] The first volume of the *Wissenschaftslehre* was reviewed in this JOURNAL, Vol. XIII., p. 328.

a technical logical signification. An elaborate and valuable historical account of the subject-matter of the second part is added. The third part deals with true propositions. The fourth part has to do with inferences; this part is also accompanied by an historical appendix.

The second part of the elementary theory, to which more than one half of the volume is devoted, treats of propositions in themselves following a scheme closely resembling that which underlies Bolzano's discussion of representations (ideas) in the first part. In sections 123–129 the proposition as a complex concept is considered; these sections may be roughly correlated with sections 38, 54, 55, 57, 76, 79, 81 of Russell's *Principles of Mathematics*. Corresponding to the domain of a representation, the domain of a proposition is introduced, as well as its extension (§§ 130, 131, p. 25). Bolzano assumes that the domain of a proposition is the same as the domain of its subject-representation (*cf.* §§ 66, 151–153). All true propositions have at least one object in their domain; there are propositions with an empty domain (§ 146), but these are *false* (§§ 137, 138, 154, 4, § 160, note). Thus the propositions "round squares are virtuous" and "round squares are not virtuous" are both false. In making this assumption Bolzano is confronted with the task of reconciling the falsity of propositions of the preceding type with the truth of propositions such as " round squares do not exist." This problem (pp. 329, 330, 404) Bolzano attempts to solve by recourse to a theory of "representation of a representation"(*cf.* symbolic representations, § 90). Underlying this problem are such logical subtleties as the truth of falsity,[2] the validity of non-validity,[3] the extension of a class which has no extension,[4] the agreement of contradictoriness,[5] the predicability of non-predication,[6] denoting concept which denotes nothing,[4] *etc.* In this connection Bolzano has rather inadequately discussed "nothing" (§ 170). The convention which Bolzano has adopted in regard to the proposition with an empty domain is opposed to the assumption of certain modern logicians,[6] while others[7] take a mediating attitude. The problem is, of course, one of modern interest[8] whose definite solution has not yet been found. A remarkable feature of the problem is its relativity. Bolzano's specific con-

[2] *Cf.* Plato, *Theætetus*, 189, Sophist, 237.

[3] *Cf.* A. Liebert, *Kant Studien*, Ergänzungshefte, No. 32, pp. 8, 143.

[4] *Cf.* Russell, *Principles of Mathematics*, §§ 36, 41, 73, 78, 100, *etc.*

[5] *Cf.* Bolzano, *Wissenschaftslehre*, Vol. II., pp. 402, 403, 421–22, 435–37, 447, *etc.*

[6] See Russell, *Principles of Mathematics*, § 73; *Principia Mathematica*, Vol. I., p. 67.

[7] For example, Peirce, *American Journal of Mathematics*, Vol. VII., p. 187.

[8] See *The New Realism*, p. 485; *Kant Studien*, Ergänzungshefte No. 26, especially pp. 104–106, 131; James, *Psychology*, Vol. I., p. 463.

vention is formally desirable in the theory of the truth or falsity of an aggregate of propositions (§ 160). A doctrine of "empty" truth[9] is convenient in the foundations of geometry; in the theory of the working hypothesis a category of irrelevancy[10] is naturally suggested. It may be added that just as in Bolzano's theory the proposition "round squares do not exist" requires explanation, so the proposition "round squares exist" is a source of embarrassment to the uniform validity of the theory of "empty" truth.

In Chapter II. Bolzano defines simple and complex, conceptual and perceptual propositions (§§ 132–133; *cf.* § 221); propositions with representations of aggregates (§ 135) of negation (§ 136); propositions determining the domain of a representation (§§ 137–139; *cf.* §§ 173, 196); propositions expressing relations between representations (§ 140); existential (§ 142); problem setting (§§ 143, 145); and convertible propositions (§ 149). In sections 147–148 certain other properties of propositions are defined by means of a technique which I shall call Bolzano's *functional operation* on given representations, propositions, *etc.* Bolzano applies this operation rather systematically in his second volume. This operation is used also in the first volume; indeed, Bolzano states (p. 314): "In the sequel we shall frequently employ the variability of certain components of a representation and the derivation of new representations by the substitution of arbitrary representations for these components." On Bolzano's functional operation are based the validity of a proposition (§ 147), the distinction between analytic and synthetic propositions (§§ 148, 197), consistence and inconsistence of propositions (§ 154–159), the independence[11] of propositions (§160), the comparative validity or probability of a proposition (§ 161), the (implicative) relation between truths called *"Abfolge"* (§ 162) and the theories in sections 164–168 which are correlated with sections 154–162. In Chapter V. of the second part Bolzano's functional operation is referred to only indirectly, *e. g.*, sections 179, 180, which discuss propositions of the form "If . . . then . . ." and "A determines B."[12] Bolzano asserts (§ 154) that the most important rela-

[9] See, for example, E. V. Huntington, *Mathematische Annalen*, Vol. 73 (1912–13), pp. 549, 550; Huntington's term "inoperative" appears to have been suggested by my term "ineffective" (*Amer. Journal of Math.*, 1909, pp. 380, 381).

[10] *Cf.* Courant, *Journal für die reine und angewandte Mathematik*, Vol. 144, p. 190; A. R. Schweitzer, *Revue de Métaphysique et de Morale*, 1914, p. 176.

[11] The term "independence" which I have used above should be compared with Bolzano's term, pp. 144, 323, *etc.* Another mathematical sense of the term occurs, *e. g.*, in Grassmanns *Extensive Algebra* (*cf.* Bolzano, Vol. II., p. 227, 2), p. 238, Vol. I., 1 (Coll. Works).

[12] *Cf.* Russell, *Principles of Mathematics*, p. 383.

tions among propositions are those arising from the application of his functional operation. Incidentally, Bolzano has thoroughly anticipated Russell's "propositional function"; this is evident from § 147, p. 78, § 233, p. 427, § 223, p. 394, § 162, p. 192, *etc.* One of the most striking of Bolzano's anticipations and which, so far as I know, has not been noticed before, is presented by his theory of relations among an aggregate of propositions arising from their truth or falsity. Here Bolzano, in effect, gives a very complete account of the current theory of so-called independence of propositions in formal logic and mathematics; in fact Bolzano's theory of independence is far more comprehensive. In beginning his discussion Bolzano states (p. 163, *cf.* § 155 p. 113): "For the discovery of new truths it is of the highest importance to know of the truth or falsity of propositions in a certain aggregate and to ascertain how many of these propositions are true or false, the propositions having the expressions as presented, or the infinitely many expressions which these propositions may assume when certain of their parts are arbitrarily varied." This view has been brilliantly confirmed by the modern developments of mathematics, notably non-Euclidean geometry and the independent investigations of Hilbert in his celebrated *Foundations of Geometry.* Among the special cases (pp. 163–170) of the preceding problem, which I shall call "Bolzano's unconditioned problem of independence" Bolzano cites (pp. 163, 2; 167, 7) an aggregate of propositions giving rise to a variable number of true propositions including as extreme cases the verification and contradiction of the entire aggregate. To express this variability notationally, let $P_1\ P_2, \ldots P_n$ be an aggregate of n propositions ($n=2, 3, \ldots$) with representations $i, j, \ldots$ for which representations are arbitrarily substituted. Then let Σ be any set of n corresponding false propositions which thus arise, Σ_{i_1} ($i_1=1, 2, \ldots n$) be any set of derived propositions such that the propositions derived from P_{i_1} is true and the remaining derived propositions are false; $\Sigma_{i_1 i_2}$ ($i_1\ i_2 = 1, 2, \ldots n, i_1 < i_2$) is any set of $[n(n-1)]/2.1$ derived propositions such that the propositions derived from P_{i_1}, P_{i_2} are true and the remaining derived propositions are false, and so on; finally $\Sigma_{12\ldots n}$ is any set of n derived propositions which correspond to $P_1, P_2, \ldots P_n$, and are all true. We have thus exhibited the range of Bolzano's variable relation based on the truth or falsity of propositions derived from a given aggregate by means of his functional operation; and, of course, for specific aggregates one or more of the sets $\Sigma, \Sigma_{i_1}, \Sigma_{i_1 i_2}, \Sigma_{i_1 i_2 i_3} \ldots$ may be "non-existent," *i. e.*, contain no propositions. In the specific example given by Bolzano (pp. 167, 170), namely, "Some X are A" and "Some X are not A" which we take as P_1 and P_2, respectively, the sets $\Sigma, \Sigma_1, \Sigma_2, \Sigma_{12}$ are all

"existent" when X is variable, as Bolzano explicitly mentions. For according to Bolzano's assumption (discussed above) when a representation with no object is substituted for X, the propositions which arise have an empty domain and are false. Examples of a relation among propositions in mathematics in close analogy with the above have recently been given.[13] With the preceding unconditioned problem of independence Bolzano has correlated a conditioned problem (p. 167) as follows: "Especially remarkable and pertinent in the theory of relations of propositions is the restriction of the variability of representations $i, j \ldots$ by certain other propositions, in particular by requiring that only such representations be selected which *verify* certain other propositions." In connection with the preceding problems of independence it is noteworthy that Bolzano actually mentions (p. 166) an example from mathematics, namely, if A, B, C are three arbitrary non-collinear points in a Euclidean plane then (certain) two of the following relations are always verified:

$$\begin{array}{lll} \text{angle } A = \text{angle } B & \text{ang. } A < \text{ang. } B & \text{ang. } A > \text{ang. } B. \\ \text{segment } AC = \text{segment } BC & \text{seg. } AC > \text{seg. } BC & \text{seg. } AC < \text{seg. } BC. \end{array}$$

This example illustrates the following unconditioned type of independence according to Bolzano: "The number of true or false propositions in the aggregate $M, N, O, \ldots$ is known and this number is invariant under the substitution of arbitrary representations for the representations $i, j, \ldots$ in these propositions." I should say that the preceding example illustrates the conditioned correlative of this type. The modern notion of independence[14] in the foundations of geometry is easily subordinated under the latter conditioned type; here the invariant number, say I, of (properly) false propositions is unity and the range of variability of the set of associated representations $i, j, \ldots$ is finite, having a number, say N, equal to the number of propositions $P_1, P_2, \ldots P_n$ $(n > 1)$ presented.[15] Although Bolzano clearly sees the value of the problem of independence in discovery, he does not seem to recognize the practical use of this problem as an instrument in logical economy; tendencies in the latter direction are indicated by p. 164, 2, p. 123, 26, p. 165, 4 and elsewhere.

In section 96 (Volume I.) Bolzano defines the convertibility, *i. e.*, same validity, of representations. In section 156 he defines the same

[13] *Cf.* A. R. Schweitzer, *Bull. Amer. Math. Soc.*, Vol. 19, p. 70. E. V. Huntington, *ibid.*, Vol. 23, p. 276, where further references are given.

[14] *Cf.* Peano, *Rivista di Matematica*, Vol. IV., p. 62.

[15] Above type of independence admits obviously an extension to $I < n$, and $N = \dfrac{n(n-1)\cdots(n-I+1)}{I(I-1)\cdots\cdots 1}$.

validity or equivalence of propositions (*cf.* § 149). The validity of a proposition itself is defined (§ 147) thus: Consider the aggregate of different true propositions derived from a given proposition by the substitution (according to a certain rule) of representations for certain representations contained in the propositions; then the validity is the relation of this set of true propositions to the entire set derived as indicated. The corresponding degree of validity is a fraction with the limiting values 0, 1 (pp. 81, 82). The validity, then, determines the degree of probability of a given proposition under certain conditions. Evidently it is a relative concept, since for a given proposition it depends on the representations assumed to be variable. Analogous to the validity of a proposition is the comparative validity (§ 161) of a proposition *M* with reference to the propositions *A, B, C, D*. . . . where in the latter the representations *i, j*, . . . are considered variable and the propositions themselves are in the relation of consistence (§ 154) with regard to these variable representations. That is, Bolzano here defines the *probability* of a proposition *M* with reference to the propositions *A, B, C, D*. . . . In section 162 a distinction between "external" and "internal" probability is made. As a magnitude, probability is a fraction with the limiting values 0, 1 (p. 172). Bolzano has made a valuable contribution to the logic of the classic theory of probability of Lacroix and Laplace (*cf.* p. 189) by his sharp formulations of fundamental concepts of this theory by means of propositions; this might be adopted with advantage in our modern treatises.[16] Bolzano's use of his functional operation in probability is paralleled by Couturat's application[17] of the "propositional function" to probability.

The third part of the elementary theory discusses exclusively true propositions and relations between these. The most remarkable of such relations Bolzano regards that of "*Abfolge*," in virtue of which certain truths are the reason (*Grund*) of others and the latter are in turn the consequence (*Folge*) of the former; in a technical sense, the relation is *dependence* (p. 323, § 221). The relation of "*Abfolge*" is mentioned in sections 162, 168 of the second part of the elementary theory; in particular in section 162, page 193. Bolzano applies to this relation the terms "material" and "formal." The formal "*Abfolge*" is a species of derivation (*Ableitbarkeit*). The concept "derivation" is discussed in sections 155–157, 162, 164. The relation of "*Abfolge*" is compared with derivation in sections 198, 200 and with causality in section 201. In sections 202, 203 Bolzano expresses the opinion that "*Abfolge*" is a simple concept; in section 221, page 388, he confesses that he sometimes suspects this relation to

[16] See, for instance, A. A. Markoff, *Wahrscheinlichkeitsrechnung*, Leipzig, 1912.

[17] *Encyclopædia of the Philosophical Sciences*, Vol. I., p. 154.

be complex and to be merely the concept of an order among truths such that from the smallest number of simple premises the largest possible number of remaining truths are derived as conclusions, *i. e.*, Bolzano suspects that "*Abfolge*" may be merged into derivation (*cf.* pp. 128–347). The relation of derivation holds between propositions "*ueberhaupt*" (§ 200) and anticipates, in essential respects, Russell's formal implication.[18] In sections 164, 179 (*cf.* § 177) Bolzano notes that the relation expressed by "if" and "then" is used to express derivation. It will be recalled that Russell[19] has observed that implication is involved in this relation. One form of Russell's material implication occurs incidentally in Bolzano's theory of derivation (p. 114); the other form, *viz.*, "implication between propositions not containing variables" (Russell, *loc. cit.*, p. 11) seems taken account of by Bolzano (§ 179) in the following words: "I do not believe that in every case in which an if and then is applied representations are regarded as variable . . . without disturbing the truth of the proposition . . . we frequently employ the if and then when no representations are regarded as variable in the compared propositions." Nevertheless, the example that Bolzano gives, "If x_0, x_1, are given integral numbers, $x_0 = 10\ \alpha_1 + \alpha_2$, $x_1 = 10\ \alpha_2 + \alpha_1$ then $x_0 - x_1$ is divisible by 9" is not, at least according to Russell (*loc. cit.*, p. 6), an illustration of Bolzano's point. It is doubtful if Bolzano recognized the extreme[20] to which material implication can be carried. Bolzano would certainly disagree with Russell's assumption[21] that implication holds between any two propositions provided the first be false or the second true. In fact, Bolzano clearly indicates (p. 483) that he regards such statements as "The square is round implies Caius is immortal" as false.

The fourth part of the elementary theory concludes Volume II. of the *Wissenschaftslehre*. This part consists primarily of developments based on the relation of derivation (*cf.* p. 128). In section 226 Bolzano explains the nature of mathematical equality, anticipating, for instance, Grassmann,[22] and points out the forms of inference on which demonstrations of equality depend (pp. 407–409). Representations with no objects in their relation to inference are persistently mentioned, for example, in sections 225, 230, 234, 236, *etc.*; in particular, in sections 234–236, inferences grounded on the denial that representations have objects, are exhibited (*cf.* 55, note). In section 247 the systematic application of Bolzano's functional operation is resumed; sections 247–253 treat inferences drawn from propositions

[18] *Principles of Mathematics*, pp. 14, 16, 33, 36, 106.

[19] Russell, *loc. cit.*, Ch. III.

[20] *Cf.* Bergmann, *Das philosophische Werk Bolzano's*, pp. 81, 89, 90.

[21] *Cf.* J. B. Shaw, *Bull. Am. Math. Soc.*, Vol. 18, pp. 392–96.

[22] *Collected Works*, Vol. I.-1, pp. 33, 34.

asserting relations between other propositions such as consistence, derivation, equivalence, probability, *etc.* These sections stand, of course, in close connection with corresponding sections of Part II. In dealing with inferences of probability (§ 253) Bolzano describes incomplete induction (p. 511) as distinguished from the complete (§ 236); the inference by analogy Bolzano regards as a particular case of incomplete induction (p. 512). Correspondingly, Bolzano indicates an extensive modification of logical processes on the basis of probability, such as improper and proper derivation, *etc.* This interesting section, diverging from Russell's views of induction, strongly supports Poincaré's remarks[23] on the latter subject. A remarkable feature of Parts III. and IV. is the use which Bolzano makes of his assumptions, "there exists a representation of widest domain" and "the number of simple concepts is finite." These assumptions occur in sections 221, 225, 226, 229, 233, 234, 236 (*cf.* pp. 150, 167 of Vol. II. and §§ 78, 99 of Vol. I.).

Volume II. of the *Wissenschaftslehre,* like Volume I., is most fascinating. Bolzano, indisputably, has made mistakes[24] in these volumes, but they are errors which, on the whole, might easily have been avoided by investigators of less aggressive originality. Both volumes offer excellent material for research.

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The Next Step in Democracy. R. W. SELLARS. New York: The Macmillan Company. 1916. Pp. 275.

Toward the great religious and social movements which have enlisted the hearts and minds of masses of men there have been two contrasting attitudes on the part of the educated and critical-minded minority. Some have been more impressed by the irrationality, the narrow dogmatism, the dangerous aspects which every such movement exhibits, and have opposed, scoffed, or ignored. Others have felt the appeal, seen the vision that it enshrined, and have sought, while identifying themselves with the movement and calling attention to its kernel of vital truth, to prune away its errors, purge it of its menace, and transform it into a force that should be wholly beneficial. This revisory and interpretative work subjects its exponents to denunciation from two sides—from the orthodox within the fold and from the skeptics without. They are called straddlers, hypocrites, heretics, traitors. But if they do succeed in leavening the movement with their saner view of its proper ends or means, in preserving its momentum and utilizing its power while making compar-

[23] *Science et Methode,* pp. 158–60, and Bolzano, W., II., p. 513, note.

[24] *Cf.* Bergmann, *loc. cit.,* pp. 66, 68, 79, 81, 89, 90, 94.

atively harmless its potentialities for mischief, they render invaluable service. We are all aware of the working of this leaven of liberalism in Christianity; most of us are less familiar with the contemporary attempt of a few large-minded and academically trained thinkers to support, and in supporting to liberalize, socialism. It is in this endeavor that Professor Sellars's book was written.

Socialism, like Christianity, is a movement pregnant with enormous potentialities. Coupled with Christianity—a real Christianity, the Way of life that Jesus taught, at present not comprehended and certainly not practised by one in a hundred nominal "Christians"—it could transform the world. Although as yet, like Christianity in its early stage, spreading mostly among the lower classes—that is, where the need of it is most keenly felt,—it already commands the allegiance of ten or twenty million human beings. But, again like Christianity, its outward expressions—the party organization, the creeds, the periodicals, and propaganda—are for the most part in the hands of the narrower-minded, the extremists, the dogmatists, men who can not see the errors in their traditional doctrine and would tie the movement down to a rigid and more or less irrational orthodoxy.

To Professor Sellars, however, the term "socialism" means "little more than a purpose, a principle, and a direction for experiment" (p. 96), the forward movement toward "a juster and humaner world" (p. 4). Concretely, socialism hopes "to reduce the disorder characteristic of the market as at present organized," "to lessen the waste characteristic of present methods," "to eliminate all degrees of competition that are obviously anti-social in their consequences," "to eliminate unmerited poverty," "to tap new energies which are now latent and are not elicited by our social arrangements," "to make labor-saving devices really saving of labor," "to procure a fair degree of leisure for each individual," "to achieve a better distribution of human costs," "to bring in its wake a society, healthier physically and morally, and one ever more capable of developing sane and progressive institutions" (pp. 50 ff.).

Many will ask, Is this socialism?—just as many ask of those who are seeking to interpret their inherited religion in terms consonant with modern knowledge, Is this still Christianity? Certainly there is nothing to shock the conservative in our author's espousal of these obviously needed reforms. He might well be content to call himself a progressive, or a true democrat, or simply a social-minded man. For those to whom the word "socialism" is a red rag, suggesting Marxism, class struggle, and violence, he will seem to be a sheep in wolf's clothing. And, on the other hand, the officials of the socialist party would presumably disavow him as comrade. Yet to the present reviewer it is a happy augury that a university professor of phi-

losophy should explicitly align himself with the great social-democratic movement, and refuse to admit that its present official pronunciamentos and its traditional dogmas are a permanent and inflexible expression thereof. For it is the spirit and purpose, the passion for a liberty and an equality that shall be more than names, the effort to reconstruct our chaotic and makeshift social order into harmony with reason and kindness, that are the soul of socialism. And if the movement is ever to fulfil these hopes it can only be by abandoning its antiquated economic theories, its cocksure dogmatism, its blind class bitterness, and adapting its programme to whatever expert, non-partisan study and cautious experimenting may show to be practicable and for the common good.

It is gratifying, then, to hear socialists warned, by one who openly espouses their cause, of "the necessarily temporary character of various doctrines associated with it," warned that "socialism must grow just as society itself grows if it ever hopes to be put into practise" (p. 23), and that "socialists themselves are often the greatest enemies of socialism" (p. 73). "Wisdom comes with experience and only a small portion of this hard-bought experience can be anticipated. Humanity is never quite certain of what it can do until it actually tries." But "so long as the movement is supple, malleable and experimental it will win out" (p. 95). "Like all things which are big and vital, it is full of possibilities, and has not come to complete self-expression. It is a movement rather than a position, as much a means of discovery and of social growth as a programme" (pp. 3–4).

In keeping with this emphasis upon the necessary plasticity and experimental nature of the movement, Professor Sellars does not attempt to describe in detail the means by which the reform of the social order is to be accomplished. He does indeed discuss in a series of chapters the application of the socialistic spirit to the problems of liberty, equality, justice, to various political and industrial problems; he even adds some reflections on the present war. But there is little here that is new or better expressed than elsewhere. And this is true of the chapters that defend socialism from its critics. In short, the book is an essay in ethics rather than in economics, politics, or sociology. The title of the book is misleading; it is a vision of the goal and an exhortation to effort rather than a sharp delineation of the "next step." For "what is needed most of all in the United States is an aroused public opinion" (p. 70). "Before America will turn to socialism it must be converted . . . it must thirst for real liberty, rational equality, justice and a noble life" (p. 21).

There is too little concrete illustration, however, and the book lacks picturesqueness or charm of phrase. It remains rather heavily

abstract, and is hardly as winning as, for example, Wells's *New Worlds for Old*, which is so closely akin in spirit. But the fairness, the temperateness and openmindedness of the author, and his clearness of vision, call for unstinted praise. And after all, what is best about the book is just its urging—and offering an example of—an alliance between university scholarship and the great, groping, half-blind, but passionate surge of the proletariat—a movement sinister with danger if left to the guidance of untrained and embittered class-leaders, but full of splendid promise if men trained to exact thinking will enter its ranks, free it from its adventitious, inadequate dogmas, and keep it true to its own deepest intent.

DURANT DRAKE.

VASSAR COLLEGE.

JOURNALS AND NEW BOOKS

THE PHILOSOPHICAL REVIEW. January, 1917. *Prefatory Note* (pp. 1–3): J. E. C.—As it enters upon its second quarter-century the *Review* announces its intention to continue the same policy adhered to from the beginning. The articles in this issue contain a survey of the main philosophical developments during the last quarter-century. *Realism and Metaphysic* (pp. 4–15): BERNARD BOSANQUET.—An interpretation of the philosophical situation prior to the year 1892. The successive phases of the nineteenth-century philosophy were: In Germany, metaphysic, epistemology, and metaphysic again, supplemented by realism; in English-speaking countries, empiricism, metaphysic, and metaphysic plus realism. The author digresses to state his conviction that the mystical element must be considered in any attempt to construe the world. *Philosophical and Scientific Specialism* (pp. 16–27): GEORGE H. SABINE.—Specialization is a necessary condition of empirical investigation. Psychology and philosophy separated with unwholesome results for both. Such an isolation of science from science and science from philosophy is unsatisfactory, and as a result an interaction of sciences has come about. *Ethics in the Last Twenty-five Years* (pp. 28–45): JAMES H. TUFTS.—Two working conceptions of the history of morality have emerged. These are, first, group life; and, second, the moral as an intimate, inseparable part of the whole process of living. These developments are the result of the scientific conception of evolution. Ethical thought has been most affected, however, by the changes in economic, political, and family life. *Some Thoughts on the Last Quarter-Century in Psychology* (pp. 46–55): MARGARET FLOY WASHBURN.—In addition to widening its field of observation, psychology has greatly improved its methods of investigation, chief among which

is the formula for calculating correlation. Comparative psychology has achieved the best results in the development of method. A strong defense is made in behalf of introspection as a method in general psychology. *The New Developments in Psychology in the Past Quarter-Century* (pp. 56–69): W. B. PILLSBURY.—A statement of the development during the last quarter-century in educational psychology, psychiatry, and animal psychology. Concludes that advance has not been toward unity or a common view-point, but toward separate problems and explanations. *Reviews of Books. Notices of New Books. Summaries of Articles. Notes.*

Armstrong, Alta Florence. The Play of Life. Boston: The Gorham Press. 1917. Pp. 81. $1.00.

Carroll, Robert S. The Mastery of Nervousness. New York: The Macmillan Company. 1917. Pp. 346. $2.00.

Croce, Benedetto. Teoria e Storia della Storiografia. Bari, Italy: Gius. Laterza & Figli. 1917. Pp. vi + 293. 6.50 L.

Diderot's *Early Philosophical Works*, translated and edited by Margaret Jourdain. Chicago and London: Open Court Publishing Company. 1916. Pp. 246.

Hindu Mind Training. By an Anglo-Saxon Mother. London and New York: Longmans, Green, and Company. 1917. Pp. xxiv + 536. $3.50.

NOTES AND NEWS

AT a recent meeting of the Council of the American Psychological Association it was voted to authorize the organization of a committee of psychologists to cooperate with the National Research Council in connection with the war. Special investigations of problems connected with military affairs, such as the examination of recruits, re-education, shock, *etc.*, will be undertaken and the resources of psychological laboratories will be placed at the disposal of the nation.

DR. H. R. CROSLAND, of the department of psychology at the University of Minnesota, has been elected assistant professor of psychology in the University of Arkansas.

AT the University of Texas Professor C. S. Yoakum has been promoted to an associate professorship of psychology and Dr. A. P. Brogan to an adjunct professorship of philosophy.